Notes For Forest Managers

Missouri Department of Conservation

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Aspect Affects Oak and Pine Basal Area and Site Index in Ozark Forests

Aspect, the direction that a stand faces, is an important topographic characteristic affecting species distribution and productivity in many forests. Aspect largely controls the amount of sunlight that the forest receives which, when coupled with temperature, affects evaporation demand. South- and southwest-facing slopes (sometimes called exposed aspects) receive more sunlight, are warmer and have a greater evapotranspiration demand than north- and northeast-facing slopes (sometimes called protected aspects). Also, aspect affects soil properties which contributes to differences in species abundance and productivity. In the Ozarks, soils on exposed aspects are more likely to be very gravelly, cobbly or stoney and shallow to bedrock than soils of neutral or protected aspects. Soils that are gravelly, cobbly or stoney or shallow to bedrock provide less rooting volume for trees and therefore supply less moisture and fewer nutrients.

Experienced foresters know first-hand how aspect effects species composition and productivity in Missouri s forests. Protected slopes often have mesic species such as white ash, northern red oak and sugar maple. These species are generally absent or in low abundance on exposed slopes. Trees on protected slopes are generally taller, straighter and have more merchantable volume than trees on exposed slopes. Because of these and other differences in forest composition and structure, aspect is often used by managers for delineating forest stands, ecological landtypes and by researchers for projecting forest growth and yield estimates.

The Missouri Ozark Forest Ecosystem Project (MOFEP) has provided an opportunity to quantify the effect of aspect on the abundance and site index of common oak species and shortleaf pine in Ozark forests. In addition to providing a wealth of data, MOFEP study sites have had very little disturbance for more than 40 years so that vegetation reflects site potential better than sites that have been grazed or logged more recently. In this management note, we compare basal area and site index of white oak, black oak, scarlet oak and shortleaf pine on four aspect classes.

How This Study Was Done

We selected MOFEP 0.5 acre vegetation plots located on backslopes (slopes >20%) that were homogeneous in geology, landform position and soils. All plots were selected from MOFEP sites 1-6 and 9 so that they represent conditions in the Current River Hills Landtype Association. Basal area for trees >1.5 dbh was calculated for the four most abundant Ozark forest species: white oak, black oak, scarlet oak and shortleaf pine. Site index in each plot was determined for these species where adequate canopy dominants and/or codominants were found and was

ABSTRACT

The Missouri Ozark Forest Ecosystem Project provided an opportunity to quantify the effect of aspect on abundance and site index of oaks and pine in second growth Ozark forests. Oaks were more abundant on neutral and protected aspects, and pine was more abundant on exposed aspects. Site index for all species was greatest on neutral or protected aspects. Stands that are uniform in aspect will be more uniform in species composition and productivity.

calculated using height, age and equations developed for the Missouri Ozarks (McQuilkin, 1974, 1978; Nash, 1963). Plots were grouped into four aspect classes: Protected (azimuths 340 to 69 degrees), Neutral-East (azimuths 70-159 degrees), Exposed (azimuths 160-249 degrees) and Neutral-West (azimuths 250-339 degrees).

What Did We Learn?

White oak, black oak, scarlet oak and shortleaf pine occurred in each aspect tested (Figure 1). Greater overall basal area occurred on neutral-west aspects, followed by protected aspects. Scarlet oak makes the greatest contribution to basal area on neutral-west aspects. Generally, white oak, black oak and scarlet oak each are more abundant on neutral-west or protected aspects than on exposed slopes. In contrast, shortleaf pine was more abundant on exposed aspects than on protected aspects. Greater basal area differences among aspect classes occurred for shortleaf pine, white oak and scarlet oak. Shortleaf pine was three times more abundant on exposed vs. protected aspects; white oak was 1.5 times more abundant on protected vs. exposed aspects. Scarlet oak was two times more abundant of neutral-west aspects than on other aspects.

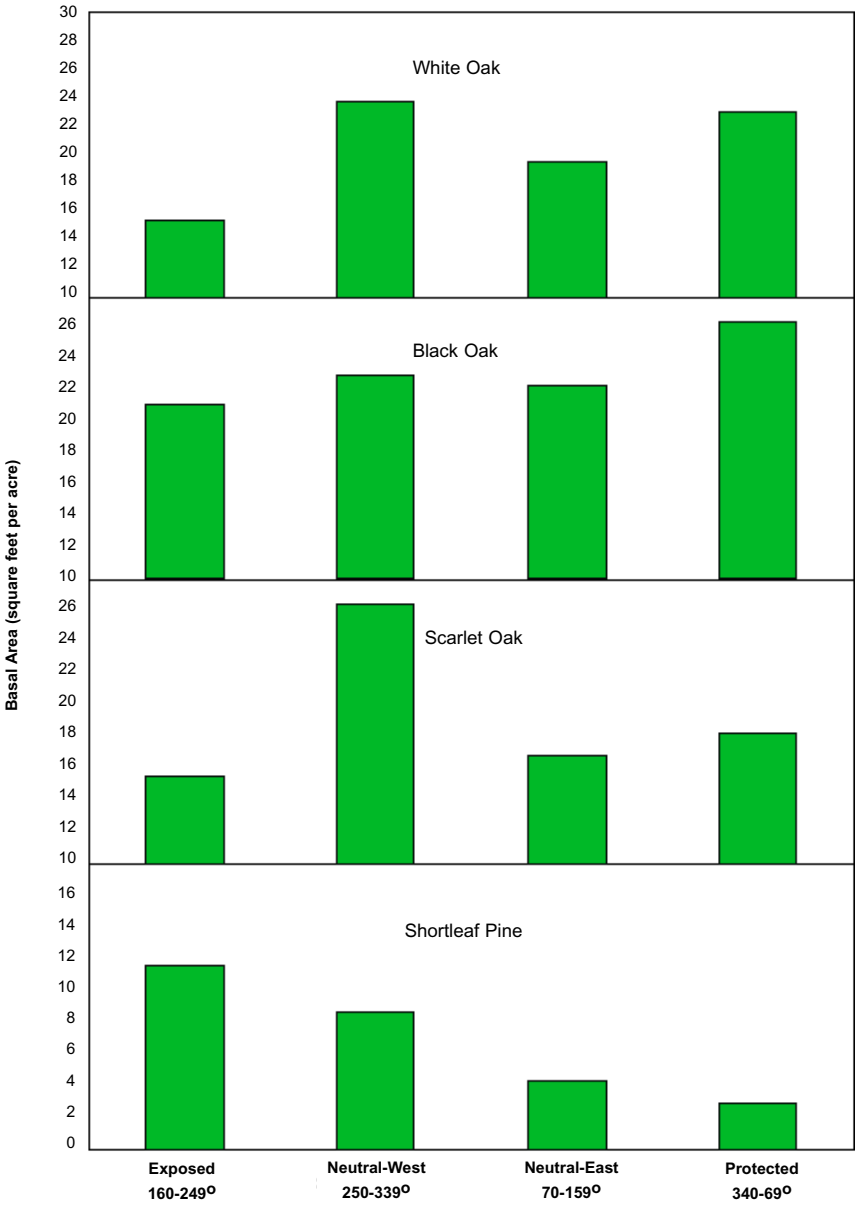

Figure 1. Basal area by aspect class

Site index for all four species was greatest on neutral or protected aspects (Figure 2). Greater site index differences among aspect classes occur for shortleaf pine and black and scarlet oak than for white oak. For white oak, we can expect 50-year-old trees to be an average of five feet taller on protected aspects than on exposed aspects, and black and scarlet may be nearly eight feet taller. Fifty-year-old shortleaf pine on protected aspects may average 11 feet taller than those on exposed aspects.

What Does This Mean?

The most common woody species of Ozark forests do show some abundance and growth differences on sites with different aspects. For most species, the greatest contrasts are observable when comparing protected aspects to exposed. The oak species investigated here are generally considered adapted to a variety of site conditions (Harlow et al., 1979; Hicks, 1998) which may explain why there were few consistent and sharp abundance contrasts among different aspects. In contrast to the oaks, shortleaf pine is clearly more abundant on exposed and neutral-west aspects. Regardless of abundance, all four species had greater site index values on protected and/or neutral-east aspects. This suggests that even though a particular species may be adapted to or competitive on a variety of sites, its growth rate will be greater on better sites.

This information supports using aspect in conjunction with other site information for delineating forest stands prior to inventorying and management planning. Forest stands that are uniform in aspect are more likely to be uniform in composition and site index. More important, they are more likely to be uniform in their response to silvicultural practices and in their long-term productivity. In other words, stands that are uniform in aspect are more likely to grow trees of similar form and quality and at similar rates than in stands that are not uniform in aspect.

Aspect is used for the delineation of ecological landtypes here in Missouri and elsewhere because of its role in governing the flow and demand for water, plant distributions and forest productivity. Aspect used in conjunction with soil and vegetation information can help identify the kinds of management most suited for a particular stand. For example, stands that contain deep, silty soils on north-facing slopes are generally suited for growing high site index oak forests. Stands on shallow to bedrock soils on south-facing slopes generally have a lower site index values and produce less merchantable volume; however, they are suitable for woodland and glade restoration.

Summary

In the Missouri Ozarks, protected or neutral slopes contain relatively more oak than exposed slopes. Shortleaf pine appears to be the only tree species that is more abundant on exposed slopes than on protected slopes. Productivity for all species, as indicated by site index, is greatest on protected and/or neutral slopes. Delineating stands by aspect will reduce variability within stands. For these reasons, aspect plays an important role in stand and ecological boundary delineation. Suitable forest management strategies can tailored to forest conditions by considering aspect in stand delineation.

References

Harlow, W.M., E.S. Harrar and F.M. White. 1979. Textbook of dendrology. 6th ed. McGraw-Hill Book Company, New York. 509 pp.

Hicks, R.R. 1998. Ecology and management of central hardwood forests. John Wiley and Sons, New York. 412 pp.

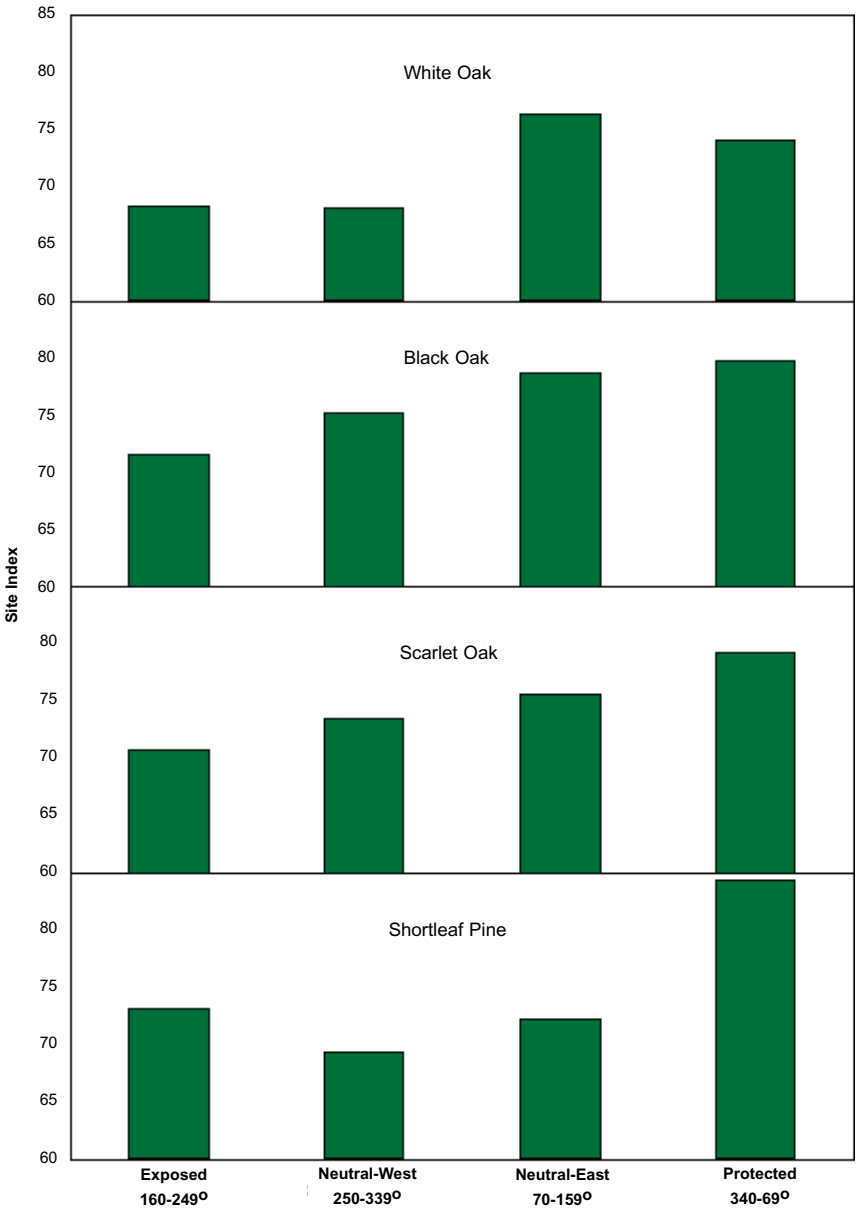

Figure 2. Site index by aspect class

McQuilkin, R.A. 1974. Site index prediction table for black, scarlet, and white oaks in southeastern Missouri. Res. Pap. NC-108. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Experiment Station. 8 pp.

McQuilkin, R.A. 1978. How to estimate site index for oaks in the Missouri Ozarks. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 8 pp.

Nash, A.J. 1963. A method for classifying shortleaf pine sites in Missouri. Res. Bull. 824. Columbia, MO: Missouri Agricultural Experiment Station. 2 pp.

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The Missouri Ozark Forest Ecosystem Project generated the data for this Note.

Invitation for Submissions

Authors are invited to submit manuscripts for Notes For Forest Managers. Notes should be field oriented and be relevant to forest land management. Submissions may be sent to:

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